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FORCED RESPIRATION.

It may be well to premise what I have to say by calling attention to the difference in the meaning of the terms used. We understand by *artificial respiration*, an artificial method of breathing for an individual ; but since forced respiration has been used, with such remarkable results, it seems to me terms should be employed which would be distinctive, and some time ago I made a suggestion to the profession which seems to have been quite universally adopted, to the following effect :

Auto-respiration: respiration by the individual for himself.

Deep Respiration: forcible respiration by the individual himself.

Artificial Respiration: this we understand to be that produced by the methods which have been suggested by Sylvester, Howard, Marshall Hall and others, in which movements of the limbs of the patient and pressure are made so as to draw the air into the lungs. In many instances artificial respiration cannot be depended on to furnish a sufficient supply of air to the lungs.

Forced Respiration: those measures by which air is forcibly passed into the lungs. (I do not advocate forcibly withdrawing it, because I think it to be an unphysiological method.)

At the late Berlin Congress Professor Horatio C. Wood, of the University of Pennsylvania, the

only American, I understand, who delivered an address before the Congress, spoke about John Hunter and others having devised an apparatus for the purpose of breathing for an individual where it was necessary to do so. I will quote from Professor Wood's address on "Anæsthesia" his remarks in this connection, which will indicate that some of the brightest lights of medicine have considered the subject of forced respiration, but have not demonstrated its value; but, through the failure of their efforts, rather relegated it to the field of impracticable methods.

The use of what may be called "forced" respiration by the physiologist so naturally suggested a similar practice in man, that the celebrated John Hunter invented for the purpose an apparatus which consisted of a bellows so constructed that when it was extended one compartment drew in air from the lungs, whilst the other drew air from the atmosphere; and when it was closed the process was reversed, the fresh air being thrown into the lungs, the foul air into the atmosphere. In 1867, Richardson, of London, invented an apparatus more elegant and portable, although identical in principal with that of John Hunter's; but I have not found that either Hunter or Richardson treated by forced artificial respiration an actual case of disease or poisoning. In 1875 (*Boston Medical Journal*, Vol. xxi.) Dr. John Ellis Blake reported a successful case of aconite poisoning, in which life was apparently saved, although there was no pulse for over three hours, by artificial respiration, with the use of oxygen. In this case Marshall Hall's method was at first used, but later a small rubber tube was connected directly with a copper reservoir of condensed oxygen, the other end of the tube terminating in a small nozzle, which was inserted in one nostril. Four hundred gallons of oxygen were thus used, but how far the force of the compressed gas was employed to dilate the lungs is not very clear; and it is somewhat doubtful whether this case should be considered as one of forced respiration. The first physician to use forced respiration in actual human poisoning, with a clear idea of its value and power, so far as my reading goes, was Dr. George E. Fell (International Medical Congress, Washington, 1877).

It is plain that the bellows constructed by John Hunter and by Richardson are unnecessarily complex and faulty in principle. There is no need whatever of drawing the air out of the fully filled lungs. Every physiologist knows that when the muscular system is completely paralyzed by woorari or even by death, that the chest-walls have sufficient elasticity to force air out of the lungs, and all ordinary laboratory apparatus for artificial respiration is based upon this fact. For forced artificial respiration in man, an ordinary bellows of proper size is all that is required for the motive power.

The real difficulty—the point to be especially investigated and studied—is as to the connection between the bellows and the lungs. Hunter and Richardson simply placed a tube in one nostril, closing firmly the other nostril and the mouth of the subject.

Dr. Fell at first used a tracheal tube, the insertion of which, of course necessitated the performance of tracheotomy. In one case, however, a simple mask covering the mouth and nostrils was a perfect success. I have had no opportunity of trying the apparatus on the living, but have made a series of experiments upon dead bodies, which have demonstrated that usually a face-mask is all that is necessary for the performance of artificial respiration. Before using the mask the tongue should be well drawn forward, and if necessary fixed in this position by an ordinary piece of suture silk run through it, which can be held in the hand of the operator. If in any individual case the mask fails, an intubation tube may be introduced into the larynx. I do not believe that it is ever necessary to perform a tracheotomy.

Dr. Fell's apparatus consists of a pair of foot-bellows (the bellows have always been used by hand power), by which air is forced into a receiving chamber, which is connected with an apparatus for warming the air, and a valve which can be opened and shut by a movement of the finger. This valve in turn leads to the tracheal tube. When the valve is opened the air rushes through the chamber into the lungs and expands them; the finger is lifted, the valve shuts, the lungs contract; and so the respiration goes on. I have no doubt that this apparatus is efficient in practice, but it is open to the serious objection of being unnecessarily complex and costly.

A much simpler, cheaper and probably equally efficient apparatus may consist simply of a pair of bellows of proper size, a few feet of India rubber tubing, a face-mask, and two sizes of intubation tubes. There should

also be set in the tubing a double metal tube, with openings so placed that their size can be so regulated by turning the outer tube (similar to that commonly found in the tracheal canula of the physiological laboratory), so that it is in the power of the operator to allow for the escape of any excess of air thrown by the bellows. I suppose this whole apparatus could be prepared at a very small cost, and it seems hardly necessary to point out its probable value in various narcoting poisonings, and in other accidents in which death is produced by a temporary paralysis of the respiratory centres. The proper use of it could be taught to persons without special medical skill, so that it ought to form a part of not only the surgeon's outfit, but might be of great service in life-saving stations, about gas-works, etc.

I will comment on Prof. Wood's article later on.

My first operation of forced respiration, was not made upon the spur of the moment. I had thoroughly considered it, for fully a year, but when the opportunity did present it was a remarkable one, and I took advantage of it. Shortly after that first operation I made a series of notes upon what I believed to be the value of the operation. These were made in my note-book in the year 1887. I then said that I believed forced respiration would accomplish more than any method of artificial respiration, either in cases of drowning, or even in cases of shock—in cases of asphyxia of whatever nature. I am glad to state now that I am more than ever satisfied of the truth of those statements. In the last case which I will report here to-night, the demonstration will bear this out.

I should like to enter somewhat into the interesting experiences which I have had since making my first operation, and the trials and tribulations to which I have been subjected in the promotion of the measure; but I presume that any one who makes an operation possessing

¹ I do not agree with Dr. Wood, reasons given further on. F.

so far reaching an import as does forced respiration, will probably have a like experience. I made my first operation in July, 1887, and saved a life which I had thought there was no possibility of saving. When I made tracheotomy in that case I felt that I was making the operation upon a cadaver, and worked accordingly. When the man gave evidence of life, I was as much surprised as any one present. I rightfully became quite enthusiastic over the operation. When some time afterward, I went to Pittsburgh as Treasurer and Custodian of the American Society of Microscopists, to attend the annual meeting of that Society, it was suggested that I might explain my methods to some of the physicians there. Some of Pittsburgh's ultra-conservative physicians, however, thought it was just as well to let me go to Washington, where I was intending to read a paper on the subject, "for fear there might be some under-hand business about it." Then, some of our Buffalo physicians intimated that what I had done was nothing novel; the operation was an old one, said they; dogs had been treated (*killed*) by forced respiration ever since vivisection came to be utilized in the medical colleges. I was well aware of that, but I had never been taught in medical college that forced respiration would *save* even a dog's life, much less the life of a human being. And this was the teaching of the world at that time. I knew that my apparatus was original in its conception, practicability and results, and took steps which assured this fact. As a further fact, to show what even at the present time the teaching is, and to indicate the necessity of repeatedly presenting this subject to the profession, I will merely state, that if you will turn to the last "Blakiston's" "Visiting List," you will find, under

“Marshall Hall’s ready method in asphyxia,” that the directions are to “avoid the immediate removal of the patient, as it involves a dangerous loss of time; *also the use of bellows or any forcing instrument.*” This is what the medical profession was taught to believe at the time I made my first operation. I was treading upon the accepted principles of the profession, and liable to severe censure had I failed in my first operation.

Well, as stated, I went to Pittsburgh, and the conservatism of the profession showed itself there by refusing to listen to what I had to say upon the subject. When later, I went to Washington, I was not heralded by any fore-runners, was acquainted with but very few individuals at the International Congress, and it was with the greatest difficulty that I had an opportunity to read my paper at all; and what was the most peculiar feature of the whole circumstance was, that, even among a class of men supposed to possess the highest medical knowledge, not any of them saw the point which presented in that first case of forced respiration, in which I breathed for a man two and one-half hours with a tube in his neck. They did not grasp that point. And I now make the statement, without fear of contradiction, that there was not a paper presented at the International Congress at Washington which had a farther reaching import, if to save human life is desirable, than that little paper on “Opium Poisoning,” which I presented—a paper embodying in it demonstrations which would alter and advance one of the greatest medical practices of the day, a practice of wide application. It demonstrated what was before not practically accepted in medicine, that we could force air into the lungs for an almost unlimited period without

danger to the delicate lung tissue. Dr. Vandenberg, of Columbus, Ohio, a disinterested observer, speaks of it as "one of the most interesting and valuable therapeutic discoveries of the day."

When I managed, however, to read my paper at Washington, they did me the kindness (?) not to publish it in the proceedings. After I had saved my third life, however, by forced respiration, and the world could not question methods which were so positive in their demonstrations, and so undeniably original, there not being a similar case on record, I had a discussion with the Chairman of a Section, and also with the Secretary-General of the International Congress, and from that discussion, which can be produced if it should be necessary, it was evident that my paper either was not carefully read, or the principal point conveyed by it was not grasped by the members of the committee.

In my first case, a man had taken 20 grains of morphia. After two and a half hours of forced respiration with the apparatus his life was saved. That is, after the dilatation of asphyxia had taken place, and all known methods had failed.

In the second case (not mine), a man had taken 8.24 grains of morphia. This case occurred in Vienna, Austria, two months after my first case. After four and a half hours of forced respiration, that is, you must note, after artificial respiration had failed to do any good, the patient was saved by forced respiration.

In the third case (my own), a man had taken 2 ounces of laudanum. It had been demonstrated that artificial respiration would not save him. He was dying. Then we began with forced respiration, and after fourteen and one-half hours

with the new apparatus which I had devised, his life was saved. That was by tracheotomy

But the fourth case came. A man had taken 2 ounces of laudanum, had severed the anterior jugular vein, and had lost a large amount of blood. For twenty-one and one-half hours continuously applied forced respiration kept him alive until he could breath for himself, and then in a few hours he asked that it be applied again. He is now living in the southern part of the States, in good health. In this case was demonstrated a very interesting point which has not been brought out prominently, which is, that in a case of great loss of blood from hæmorrhage it does very little good to inject ether or brandy into the peripheral capillaries, unless you can inject it into, or proximally to a large vein, where you know it will be taken into the circulation. The patient laid in bed nearly two months merely because the ether and brandy which had been injected into the chest produced a gangrenous condition of the tissue. The fluid was not carried off by the capillary circulation, and the muscles of the chest sloughed away, down to the ribs. In the thigh, where injections had also been made, owing to the same cause existing, a weak or very slow capillary circulation, an abscess formed, and a cup of pus was removed on the first incision. This demonstrated very interestingly the necessity of care in the employment of hypodermic medication where there is excessive hæmorrhage.

Following these interesting cases, came a series in which the results were not so successful. An old gentleman, 80 years of age, had taken 1 ounce of laudanum. At the hospital artificial respration was used, the hospital physicians gave him up. Then forced respiration kept him alive for some twelve hours after that.

One of my most interesting cases was a little child, 18 days of age, of one of our prominent citizens, which had accidentally been given 1 grain of morphia by a physician of the homœopathic school. The little one took the whole of the poison, equivalent to about eighty doses, and came under the influence of it. It was given about a quarter to one. I was called at five o'clock. Without proper apparatus I went to work and made tracheotomy, a most difficult undertaking in one so young; but I succeeded in getting down to the trachea. I then with a small catheter inserted into the trachea, kept up forced respiration, with bellows and valve, with the result that the little one, which was markedly cyanosed, became of a natural hue, the blood became oxygenized, and it breathed for itself a short time. The bowels moved and the evidence was strong that the child might live. But owing to the long time during which the asphyxiated condition had lasted through the influence of the poison, it was too much to expect that we could retain the vital condition of the tissue of the brain for a sufficient time, as was demonstrated by the heart failing to act some four hours after the forced respiration was begun, when death supervened. This was one of the most striking demonstrations I ever had of the value of forced respiration.

Again, it is usually conceded that when you can obtain no pulse at the wrist and no heart action on auscultation, that an individual is (nearly) dead. This condition existed in one instance which occurred. It was a case of opium poisoning. The day before this case presented, I was about to make tracheotomy and carry out my operation in another case, when I noticed indications that the patient would probably live with-

out it; we waited, and he did pull through without the operation. The next day I had the case referred to. I waited until there was no pulsation at the wrist, and could detect no heart action on listening over the chest-wall. I then made tracheotomy. The blood was markedly venous, but upon passing oxygen into the lungs it became oxygenized and red, and furthermore, the heart action became distinct, and the pulse again was present at both wrists. But after an hour the heart again ceased beating. I had waited a little too long before beginning the forced respiration.

After this I demonstrated another method, by which we could perform forced respiration without tracheotomy, and the first application of it occurred in trying to keep alive a still-born infant by passing a tube into the mouth and compressing the nostrils; I succeeded in keeping it alive for a number of hours. Owing, however, to compression of the brain produced in labor which existed, there was evidently no chance for the child to live, and I gave up the attempt. So long, however, as the forced respiration was kept up, the heart continued to beat.

Then came another case which demonstrated, also, that life can be kept up by forced respiration without tracheotomy. A man had taken 2 ounces of laudanum. One of the physicians² present called attention to the dilatation of the pupils as an indication of the very near approach of death. I had begun to make the operation for tracheotomy, but found the blood markedly venous. I stopped, and inserted the tube of the apparatus in the mouth, closed the nostrils and forced air into the lungs through the mouth, and had the satisfaction of seeing the blood in the

² Dr. Carlton C. Fredericks.

neck turn from a dark purple to bright scarlet, indicating that there was sufficient heart action to carry the oxygenized blood through the system, and demonstrating the valuable fact that through the mouth and the nostrils sufficient air could be made to pass to the lungs for a time to retain life without the necessity of tracheotomy. This subject seemed to have a mania for committing suicide by taking laudanum, and afterward took 2 ounces of laudanum and about 5 or 6 grains of morphia; I repeated the operation of tracheotomy, and again saved him. Upon making a third attempt he was sent to the asylum, and is now, I believe, cured of his peculiar habit.

Another case presented in which a young woman took 2 ounces of laudanum; by breathing for her four hours with the face-mask alone, her life was saved, *i. e.*, without tracheotomy.

Now comes a case which I want particularly to call your attention to, as one in which some facts were demonstrated which I had been waiting for for a long time. Dr. Wood, while admitting that I made the first comprehensive operation of forced respiration, criticized the apparatus used, and in reply to his objections I desire to state that when I made my first operation it was with incomplete apparatus, and it was surprising on this account that I did not lose the case. Had I failed it would probably have "settled" the question of forced respiration. Before, however, attempting to construct a suitable apparatus, I very carefully considered the details and the conditions to be met, and the apparatus as finally devised consists of a tracheotomy tube, a tube connected with the air-control valve, and then a tube connecting that with the air-warming apparatus, which in turn is connected with the bellows by another tube. With

this apparatus, whether on board of a ship, or even on the ice, or elsewhere you can supply the human lungs with air at the temperature of the body within five or ten minutes at the most from the time you begin, and can keep it up for an unlimited time. So it will be seen that while my apparatus covers almost all the conditions for every case that may present, yet it also answers for the *most simple method possible* in forced respiration. That is, you can use the face-mask, rubber connecting tube and bellows alone, or the face mask, air control valve and bellows alone, which I would by all means recommend as much better than the former combination. In this last case, a woman had taken an uncertain amount of morphia—a large amount, however, as was evident from the effect produced upon her. About midnight a physician was called, but refused to attend, so that she was under the influence of the narcotic all through the night, until about 10 o'clock the next morning. I was called at 9 A.M., and arrived about 9:30. I ascertained there was no pulse at either wrist, but on auscultation found the heart faintly acting, cyanosis deep. I then had her placed upon a mattress in an adjoining room, and with the face-mask, air-control valve and the bellows, went to work. I digress again to state that the point of interest in connection with this air-control valve is this, the moment you press the lever the air passes into the lungs; release it, air can pass out of the lungs, or it can pass into the lungs (though not from the bellows), or auto-respiration can take place. The moment the valve is pressed down, though the bellows may be ten or twenty feet away for that matter, yet the air is under continual pressure, and enters the lungs from the valve without any loss of time. You have abso-

lute control of the air passing to the lungs ; and this is the important factor in the whole proceeding. (Also in the use of the valve, as improved oxygen can be systematically administered). If you had the bellows and the face-mask alone, the air would necessarily have to come clear from the bellows, through the tube, to the face-mask, before you could be sure of its passing into the lungs, and consequently the respiration could not be carried on so satisfactorily. Dr. Vandenberg's apparatus operates, I believe, so that when you work the bellows air passes into the lungs ; but when you stop the bellows, the flow of air ceases ; and I do not think there is as quick control of air passing to the lungs as by the method I have used so satisfactorily. Furthermore, all the physician has to do is to work the air-control valve, and any one can work the bellows, which is the work in which physical exertion is expended. In the case now under consideration, I worked for fully an hour and a half before the pulse at the wrist could be detected. The woman then became conscious, sat up and asked for a drink.

In the middle of the afternoon, Dr. Porter came in to witness the operation and offered his assistance, which was accepted. It may be stated that when a person is very deeply narcotized, with forced respiration we may occasionally produce a conscious condition, but the patient will again pass under the influence of the narcotic, and become utterly unconscious. You may breathe for him or her for half an hour at a time, yet there will be no evidence of life except the action of the heart and the fact that the blood is supplied with oxygen. So this lady would occasionally become conscious. During one of these conscious periods Dr. Porter, who had been standing in one corner of the room, came forward and began to

perform Sylvester's method of artificial respiration—with the object, I presume, of demonstrating that it would accomplish as much as what I was doing. He understood how to apply that method from previous experience. All watched the result with interest. In a little while, the cyanotic condition began to appear along the face, gradually becoming deeper and deeper. I said, "Doctor, you see now just what the result is." "Yes," he said, "there is no question about it." We then renewed the forced respiration with the face-mask. In a short time the cyanotic condition disappeared, and the woman again became conscious. I regard it as a very important and interesting fact to state, therefore, that we had here a demonstration that forced respiration with the face-mask will accomplish more than the best of the methods of artificial respiration in use in the past throughout the world. You can save life by forced respiration by this method when you cannot possibly do it by any method of artificial respiration whatever. I kept up forced respiration with this woman until she revived again, and began to be in quite a jovial condition, and as I thought, was perfectly safe. Then Dr. Porter desired to try the Faradic battery, which I consented to, regarding the woman's condition such that, were it necessary, we could at any time rely upon the forced respiration again. I was anxious, of course, to report this as another case of life saved by forced respiration. After breathing some eight hours and carrying the case through the most critical period, we called the Faradic battery into play. But what is the result of faradization in a case of that kind? Merely the stimulation of the heart at the expense of its energy. However weak the current may be, if you obtain any heart action, it is of a tonic na-

ture, and secured at the expense of the energy of the heart muscle. What we need to look out for in such a case is to conserve the energy and the vitality of the heart muscle. In this case the result was that after about three-quarters of an hour of faradization the heart stopped beating, spasmodically. The case was lost through faradization.

Now, a moment to consider the relative value of tracheotomy and of the face mask in forced respiration. Is tracheotomy any better than the face mask? Prof. Wood, of Philadelphia, says he does not think it will ever be necessary to resort to tracheotomy. My belief is, founded on this last case, that in a long-continued operation it is possible to breathe for the patient more easily and thoroughly by resorting to tracheotomy. In respiring for a person with the face-mask, it must be remembered that the passage to the stomach is open, and the air passes down the œsophagus to stomach and intestines. This presents the difficulty in working with the face-mask. If it is desired to eliminate poisons the patient may be given anything without danger of fluids passing into the trachea, by the tracheotomy method; and you have better control of the patient. If I had a case in which I thought I should have to respire for the patient for eight or ten hours or more, I would make tracheotomy, feeling that I could accomplish more, and have more thorough control of the patient.

I do not recommend as yet intubation, because I think there are many cases, in fact have seen many, where it was not practicable owing to the difficulty of intubating the larynx; and if we can pass air into the larynx or trachea without intubation, as by the face-mask, it is of course always better to do it. This is my opinion, from the ex-

perience derived in operations on a dozen living beings.

In these experiences I have encountered, I think, quite a number of facts bearing upon the treatment of opium narcosis which are both new and valuable; but I will not refer to that at the present time. I merely wish at this time to call attention to the interesting fact that with the face-mask and forced respiration more can be accomplished, as I believe, than by any method of artificial respiration; and the widely accepted dictum of Marshall Hall that we must use no forcible measures, leads me to give unusual emphasis to this statement.

I will merely add, in closing this inpromptu talk, that fifteen lives are so far to be credited to the operation of forced respiration. When it comes into general use in cases of drowning, shock, the tiding over of critical cases, in asphyxia from whatever cause, as well as from narcotic poisons, who will not admit it is one of the most important procedures at our command?

